

## **Safing System Phase 1 Thread**

### **Atlas DP1 Assessment**

### **Checkout and Launch Control System (CLCS)**

**84K00303-001**

Approval:

\_\_\_\_\_  
Chief, System Engineering and  
Integration Division

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

NOTE: See “**Supporting Document Note**” on following page

**PREPARED BY:**

Rick Dawson

---

---

---

---

---

---

---

---

**Supporting Document Note:** Acronyms and definitions of many common CLCS terms may be found in the following documents: CLCS Acronyms 84K00240 and CLCS Project Glossary 84K00250.

### REVISION HISTORY

REV	DESCRIPTION	DATE
Draft.2	Update to standard format. ljp	5/18/98

Printed documents may be obsolete. Check the CLCS Documentation Base web pages for current approved revision of this document before using it for work

## Table of Contents

<b>1. INTRODUCTION .....</b>	<b>1-1</b>
1.1 SAFING SYSTEM OVERVIEW. ....	1-1
1.2 SAFING SYSTEM CONCEPT.....	1-1
1.3 SAFING SYSTEM SPECIFICATION .....	1-1
1.3.1 Statement of Work.....	1-1
1.3.2 Requirements .....	1-2
1.4 SAFING SYSTEM DELIVERABLES .....	1-4
1.5 SAFING SYSTEM ASSESSMENT SUMMARY .....	1-4
1.5.1 Labor Assessments .....	1-4
1.5.2 Hardware Costs .....	1-4
1.5.3 Safing System Procurement .....	1-5
1.6 SAFING SYSTEM SCHEDULE & DEPENDENCIES .....	1-5
1.6.1 Schedule .....	1-5
1.6.2 Dependencies.....	1-5
1.7 SAFING SYSTEM SIMULATION REQUIREMENTS .....	1-5
1.8 SAFING SYSTEM INTEGRATION AND SYSTEM TEST .....	1-5
1.9 SAFING SYSTEM TRAINING REQUIREMENTS .....	1-5
1.10 SAFING SYSTEM FACILITIES REQUIREMENTS .....	1-5
1.11 TRAVEL REQUIREMENTS.....	1-5
1.12 SAFING SYSTEM ACTION ITEMS/RESOLUTION .....	1-6
<b>2. CSCI ASSESSMENT.....</b>	<b>2-1</b>
NONE .....	2-1
<b>3. HWCI ASSESSMENTS.....</b>	<b>3-2</b>
<b>4. COTS PRODUCTS DEPENDENCIES .....</b>	<b>4-1</b>
4.1 SW PRODUCTS DEPENDENCY LIST .....	4-1
4.2 HW PRODUCTS DEPENDENCY LIST.....	4-1

## SAFING SYSTEM PHASE 1 THREAD

### ATLAS DP1 ASSESSMENT

#### CHECKOUT AND LAUNCH CONTROL SYSTEM (CLCS)

## 1. INTRODUCTION

### 1.1 SAFING SYSTEM OVERVIEW.

This thread provides the initial Safing System design and prototype units. The Safing System provides an alternative means of safing the Vehicle/GSE in the event of an RTPS failure.

### 1.2 SAFING SYSTEM CONCEPT

The initial concept for the Safing System prototype was an extremely flexible design which allowed any panel to be any system (LOX, LH2, etc.) connected to an I/O controller at any place (PadA, VAB1, etc.). The first prototype implementation utilized dual flat screens with touch overlays and a single-board computer for each panel; a dedicated 10BaseT safing network; and I/O controller modules for each system at each place. During discussions with the customers the requirements for the CLCS Safing System have been reworked and the design priorities have been re-addressed. The reliability numbers for the CCMS Emergency Safing System(ESS) and the initial concept are being calculated to determine the acceptability of the new concept. In parallel, other concepts are being worked with the new requirements and design priorities in consideration. Although there may be other options, at this time the development team envisions one of three basic designs evolving. 1) A design similar to the initial concept but perhaps with less complicated equipment for reliability purposes. 2) A design similar to CCMS's ESS but with perhaps a more modular design (but not necessarily since we might find the VLPS safing panels). 3) A combination of computer/network based panels and hardwired switch panels with the "launch-day" panels remaining basically the same as CCMS.

### 1.3 SAFING SYSTEM SPECIFICATION

#### 1.3.1 Statement of Work

- Analyze the SLS and "Other Requirements" that are included and provide an assessment in DP1 of:
  - Whether the requirement is incorporated into the Atlas release,
  - The level of maturity the requirement will achieve in Atlas
    - Low = function only implemented in one subsystem,
    - Medium = function implemented in multiple CSCIs/Subsystems, but capability not available across the entire system,
    - High = function is implemented nearly everywhere, or
    - Complete = function is implemented everywhere that it is needed
- If the requirement will have to be verified for HMF to be declared operational
- Provide system design for [the sSafing System](#) at all facilities.
- Develop [Hardware the Safing System Panels](#) Concept
- Prototype [Hardware-Safing System](#) Panels
- Evaluate COTS [Hardware-Safing System](#) Panels

- Deploy ~~a in Hardware~~ Safing ~~System~~ Panels in LCC X
  - Gather user feedback.
  - Design interface hardware to CCMS hardware safing system.
  - Prototype interface hardware to CCMS hardware safing system.
- ~~□ Begin design of ESS Safing Manager~~
- Begin Developing ICDs for BioMed ~~Vehhical Safing~~ and Launch Data Bus Vehicle Safing.

### 1.3.2 Requirements

Current SLS Requirements with recommended changes -

#### Hold Switch Interface

CCMS supports an external interface to 'hold' switches at various non-CLCS positions in the OCRs. These switches allow various management personnel to 'hold' a launch. The switches in the CCMS system are located at the NTD position, Range Safety, and GLS. In CCMS, these switches generate an interrupt in the PFP that is fielded by a GOAL application program.

The RTPS shall be capable of accepting a discrete signal from a minimum of three locations per OCR to 'hold' a countdown.

#### Hardware Safing System Interface

The Hardware Safing System provides an alternate means of controlling and monitoring critical GSE in the event of a failure of the RTPS. This consists of mostly hardwired 28V lines that perform two functions: cut-off the power to selected HIMs, thereby returning their outputs to a zero (de-energized) state; and provide direct control and monitor of selected GSE components. Separately, a Flight Vehicle Safing capability is provided as detailed in Section 2.2.7- Safing and Biomed Requirements.

The RTPS shall be capable of accepting 28V discrete and analog signals from the Hardware Safing System.

The RTPS shall be capable of outputting user supported ~~outputting 28V~~ discrete ~~and analog~~ signals (relay closure) to the Hardware Safing System.

The RTPS shall interface to the existing Hardware Safing System at the Hardware Safing Patch Panel using Pad, OPF, and VAB wiring, sensors and effectors.

#### Safing and BioMED Requirements

The RTPS must provide a totally separate system that provides the capability to bypass the primary Command and Control portion. This system is referred to as the RTPS Safing System and consists of two major areas: LDB Vehicle Safing and Hardwired Safing. Both areas have Safing Panels for their HCI. Hardwired Safing is connected directly to sensors and effectors at the test site (e.g., PAD, VAB, etc.). In CCMS, LDB Vehicle Safing ~~Vehicle Safing~~ is connected to the LDB Gateway only at the PADs and SAIL. CLCS shall not preclude the addition of other sites in the future, where LDB Vehicle Safing ~~Vehicle Safing~~ Sequences are loaded and executed. LDB Vehicle Safing ~~Vehicle Safing~~ is connected to the OFI PCM Downlink in order to acquire measurement data to be displayed on the panels.

The CLCS must also provide a BIOMED capability for the display of astronaut biomedical data on the BIOMED console. The BIOMED data must be acquired from the OFI PCM Downlink. The CCMS Vehicle Safing and BIOMED (VSB) Gateway will be utilized as the mechanism to acquire the PCM data for both Vehicle Safing and BIOMED. The BIOMED console will be incorporated into a RTPS workstation (TBD).

#### RTPS Safing

The RTPS Safing System shall provide a totally independent Safing capability for the emergency control and monitoring of critical and/or hazardous systems. The RTPS Safing System consists of two major areas: LDB Vehicle Safing and Hardwired Safing

The Safing System shall be a very reliable system with less than 1 ~~?????~~ (TBD) failure per year in the LCC Set.

A separate Safing System shall be provided for every End-Item Site supported by the LCC Set (VAB1, VAB3, OPF1, OPF2, OPF3, PADA, PADB).

The RTPS Safing System shall provide the capability to place the Test Article and support equipment in a safe state.

~~The Safing System panel shall be easily re-configurable to support movement of function from one Console Position to another.~~ The Safing System shall support the reduction from 4 (CCMS) to 3 (RTPS) control rooms by providing enough flexibility during non-integrated operations.

Any portion of the safing system which is computer based shall provide health, status, System ID and place information.

~~A RTPS Safing System panel components shall be provided as required at every command and control console position in the LCC Set and the SAIL Set.~~

EMI induced glitches shall not initiate a Safing command.

#### LDB Vehicle Safing

The RTPS Safing System shall provide the capability to execute LDB Vehicle Safing~~Vehicle Safing~~ Sequences that are initiated by the user on a Safing Panel at the User Console Position.

The RTPS Safing System shall provide a master enable function that enables one (or none) of the LDB Gateways to execute LDB Vehicle Safing~~Vehicle Safing~~ Sequences.

The RTPS Safing System shall support executing a LDB Vehicle Safing~~Vehicle Safing~~ Sequence in less than ~~15000~~ milliseconds from user initiation to the start of the Safing Sequence execution.

~~EMI induced glitches shall not initiate a LDB Vehicle Safing Sequence.~~

The Active, Standby, Dual and Hot Spare LDB Gateways shall be capable of supporting LDB Vehicle Safing~~Vehicle Safing~~ but only the currently enabled Gateway will execute LDB Vehicle Safing~~Vehicle Safing~~ Sequences.

The RTPS Safing System shall support a minimum of 32 predefined independent LDB Vehicle Safing~~Vehicle Safing~~ Sequences.

The RTPS Safing System shall provide the capability to Display PCM Downlink Safing data on Safing panels.

The RTPS Safing System shall provide the capability to enable/inhibit individual LDB Vehicle Safing~~Vehicle Safing~~ Sequences.

The RTPS Safing System shall provide the capability to load LDB Vehicle Safing~~Vehicle Safing~~ Sequences into an active Gateway without disrupting operation of that Gateway.

The RTPS Safing System shall provide the capability to unload (logically remove or delete) LDB Vehicle Safing~~Vehicle Safing~~ Sequences from an active Gateway without disrupting operation of that Gateway.

All activities in progress prior to a power failure, except for LDB Vehicle Safing~~Vehicle Safing~~, shall be purged from the LDB Gateway when power is restored.

The LDB Gateway shall support LDB Vehicle Safing~~Vehicle Safing~~ within 8 seconds after power restoration.

#### Hardware Safing

The RTPS Hardware Safing shall provide the capability to execute commands initiated by the user on a Safing Panel at the User Console Position.



The RTPS Hardware Safing shall support initiating an output in less than 150 milliseconds from user initiation to the output of the effector.

The RTPS Safing System shall provide a function that enables one or more of the commands on a Safing Panel.

Hardwired Safing shall provide direct GSE effector control from the Safing System.

Hardwired Safing feedback data shall be accomplished by GSE sensors returning hard-wired voltages directly to the Safing System.

#### BIOMED

The RTPS shall provide the capability to Display OFI PCM Downlink BIOMED data at the BIOMED console position(s).

### THE DESIGN DRIVERS WE WILL USE TO DEVELOP THE NEW SAFING SYSTEM (In priority order)-

1. Provide a separate Safing System with the capability to safe the vehicle/GSE when the primary control system has failed
2. Provide an extremely reliable Safing System with a similar failure rate as the current CCMS safing system
3. Provide the capability for ~~countdown~~ safing operations to be performed at more than one console for each system to allow more flexible ~~flexible~~ scheduling.
4. Provide a Safing System that requires minimal maintenance and operations personnel/time. (e.g. minimize/eliminate the physical reconfiguration/patching required, use commercial products, do not have 22 totally custom panels for each of 22 systems, etc.)
5. Provide improved readability/useability of analog FDs displayed on safing panels ~~a better display capability for the analog meters~~
6. When a console fails, provide the capability for that consoles safing panel to remain in close proximity with the new console.
7. Consider the new GSE replacement project (IMT).

#### 1.4 SAFING SYSTEM DELIVERABLES

Prototype Safing Panel and I/O Controller with imbedded S/W

#### 1.5 SAFING SYSTEM ASSESSMENT SUMMARY

##### 1.5.1 Labor Assessments

The total Labor Costs required to provide this capability are summarized in the following table;

No.	CSCI/HWCI Name	Atlas LM	Changes covered in
1	Safing System	9.0 LM	
	TOTAL	9.0 LM	

##### 1.5.2 Hardware Costs

The total Hardware Costs required to provide this capability are summarized in the following table:

Item number	Name	Unit Cost	Qty.	Total	Assumptions
-------------	------	-----------	------	-------	-------------

Item number	Name	Unit Cost	Qty.	Total	Assumptions
1	Safing Panel	\$8,000	1	\$8,000	
2	I/O Controller	\$6,000	1	\$6,000	
		<b>Total:</b>		<b>\$14,000</b>	

### 1.5.3 Safing System Procurement

The equipment for the prototype Safing System (Initial Concept) has been procured.

## 1.6 SAFING SYSTEM SCHEDULE & DEPENDENCIES

### 1.6.1 Schedule

Task Name	Start	Finish
Atlas DP1		5/12
Review Proposed Reliability Requirements		5/27
Concept Review with users (includes concepts considered, reliability numbers and SLS requirements update)		6/26
Safing System White Paper		7/3
Atlas DP2/DP3 (Design Review)		8/28
Prototype Complete		12/1/98
Prototype Demonstration		12/15/98

### 1.6.2 Dependencies

None

## 1.7 SAFING SYSTEM SIMULATION REQUIREMENTS

None

## 1.8 SAFING SYSTEM INTEGRATION AND SYSTEM TEST

None

## 1.9 SAFING SYSTEM TRAINING REQUIREMENTS

None

## 1.10 SAFING SYSTEM FACILITIES REQUIREMENTS

NONE

## 1.11 TRAVEL REQUIREMENTS

None

## **1.12 SAFING SYSTEM ACTION ITEMS/RESOLUTION**

None

## **2. CSCI ASSESSMENT**

NONE

### **3. HWCI ASSESSMENTS**

None

#### **4. COTS PRODUCTS DEPENDENCIES**

None

##### **4.1 SW PRODUCTS DEPENDENCY LIST**

None

##### **4.2 HW PRODUCTS DEPENDENCY LIST**

None